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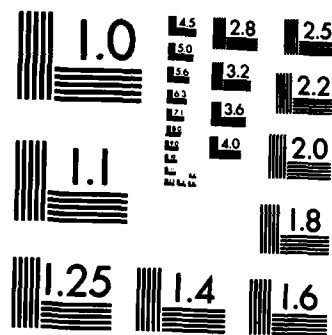
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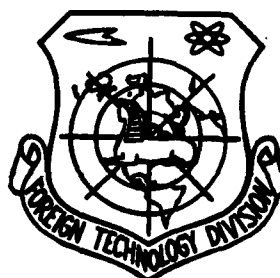
FOREIGN TECHNOLOGY DIVISION



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by

Zhao Xu and Fan Lusheng



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DEFENSE AGAINST SPACE WEAPONS

Zhao Xu and Fan Lusheng

After the Soviet Union put up the first artificial satellite 24 years ago, the competition for outer space immediately began. The Soviet Union and The United States have put thousands of satellites and spacecraft into space. A considerable portion of these satellites and spacecraft have become space weapons used for military purposes such as photo reconnaissance, electronic reconnaissance, early warning, navigation, and communications. Based on U. S. statistics, from 1957 to December 1980, the USSR and the U.S. carried out a total of more than 2400 unmanned space launches. The USSR outdid the U.S. by more than 600 launches. Approximately half of all these spacecraft launched were of a military nature, accounting for 61% and 41% of those of the USSR and the U.S., respectively. Recently, new types of spacecraft have been successfully tested which can have a number of functions simultaneously, such as reconnaissance, early warning and surveillance, which can also put into orbit, recover, analyze and repair reconnaissance satellites of various uses, and which can also seize spy satellites which are in operation. The emergence of the space shuttle is causing the struggle for domination of space to enter a new stage of development.

Spacecraft used for reconnaissance can gather important military intelligence and some space weapons in particular can also perform strategic nuclear attack missions, posing an even more direct threat to national security. Thus, defense against space weapons has become one of the crucial issues in safeguarding national security. A number

of countries are actively developing defensive systems against space weapons. At present, these systems include the three components of observation, identification, and destruction.

COMPREHENSIVE OBSERVATION CLOSE SURVEILLANCE

Observation is an important prerequisite for defense against space weapons and only if space weapons are observed in the vastness of space, their orbital parameters accurately determined, and they are able to be identified and destroyed will the necessary conditions be created. Consequently, systems for carrying out observation of space weapons occupy a special position in space defense deployment systems.

Space weapons are different from aircraft and missiles. They can be put into space during peacetime and according to international space law destroying them is not permitted. This requires an area of defense which must comprehensively observe and keep under surveillance all the spacecraft in space during peacetime, differentiate from among these the space weapons for military use and, in particular, must observe reconnaissance satellites and nuclear bomb carrying satellites, in order to take counter-reconnaissance and counter-destructive measures and, in case war breaks out, effective destructive measures can still be immediately employed. Therefore, the observation and surveillance of space weapons seems to be even more prominent and important.

At present, the facilities used to observe space weapons are mainly ballistic missile early warning system radar, space surveillance and tracking system radar, astrophysical observation center tracking stations, and electronic reconnaissance facilities. In 1961, the U.S. began building a space detection and tracking system, with its command center set up in the vicinity of North American Air Defense Headquarters, in order to gather and process spacecraft related intelligence obtained by the various observation systems.

For the sake of timely detection of spacecraft launchings, the U.S. uses missile early warning system over-the-horizon radar which depends on short-wave radio waves propagated by reflecting off the

ionosphere. They use early warning satellites which pickup the infrared radiation from rocket engines and they use reconnaissance equipment which picks up the subsonic waves (0.05Hz to 2.5Hz) which are produced when a spacecraft is launched. To carry out surveillance and tracking of spacecraft which have already gone into orbit, in 1963, the U.S. mainly used AN/FPS-50 and AN/FPS-49 ultra-long range early warning and tracking radar which detected targets at a distance of 5000km. In order to accurately determine the location and orbital parameters of the spacecraft, beginning in 1968, the U.S. also used AN/FPS-85 phased-array radar. The detection range of this kind of radar is over 7000km, it can simultaneously track over two hundred targets and search for forty unknown targets. In 1977, the U.S. put the even more advanced AN/FPS-108 phased-array radar into service. The large satellite detection range of this new type of radar, which is also called "Cobra Dane", is up to 46,000km. It can simultaneously track 200 targets flying in outer space and 300 missiles and has very high detection accuracy. In addition, with the astronomical telescope at the U.S.'s Smithsonian Astrophysical Observatory, spacecraft 160,000km from the earth can be observed and photographed. As for communications satellites and similar kinds of spacecraft which emit electromagnetic waves, their orbital parameters can be determined by electronic reconnaissance facilities or passive radar. At the same time, other methods and facilities for detecting and tracking spacecraft are also being studied. For example, the problem of using laser radar is being intensively studied.

CAREFUL ANALYSIS ACCURATE IDENTIFICATION

The most complicated problem for space defense is spacecraft identification. There is now in space a large number of spacecraft launched by many countries and distinguishing their nationality and purpose is not very easy. In particular, satellites carrying nuclear weapons often remain "silent", do not emit any signals whatever and their appearance may take on many and various disguises. Identifying them becomes even more difficult. In order to determine an artificial satellite's use, we must first determine its orbit, appearance, dimensions, volume and weight. If complete and accurate identification is desired, then it must be determined that there is no reconnaissance equipment on the satellite and, more importantly, no nuclear weapons.

At present, there are primarily two methods of identifying satellites: ground identification and space identification.

Identification of artificial satellites from the ground is done in the U.S. by radar and by optical equipment. Radar identification uses the method of meticulous analysis of return waves. The return wave is divided into several components, recorded in digital form and then processed by computer. This involves making comparisons with known return waves which are stored in it which can approximately determine the spacecraft's shape, size, material and its stability around the spin axis. Identification using optical instruments can serve as a complement to radar identification. If the resolution of the optical instrument is less than 30cm it will also be able to clearly see the spacecraft's markings and the location on the spacecraft of certain distinct features such as windows, antennas, and engines. But identification of satellites using radar and optical instruments is not very accurate. The use of this kind of equipment can assume only the simplest identification role.

Identification of spacecraft from space can be done using artificial satellites, deep-space craft, and space shuttles. These spacecraft are guided from the ground to the vicinity of the target. They use electro-optical or optical instruments to get pictures of the target's appearance which are then radioed back to earth for making analytical determinations. The work of identifying artificial satellites can also be accomplished by astronauts in spacecraft. However, using these kinds of methods only make possible a general determination of identity of the spacecraft's configuration and, as far as "what it is up to", it is very difficult to actually determine. At present, manned and unmanned space vehicles used for identification are being tested.

Comprehensive analysis is conducted on the basis of operational orbit, flight pattern, and data obtained by other means of observation, and the uses of most spacecraft can be basically determined. The results of identification can be stored in a computer and during the course of subsequent tracking and surveillance further identification of the spacecraft will continue to be carried out based on

newly obtained data in order to acquire even more accurate results.

PRECISE GUIDANCE EFFECTIVE DESTRUCTION

Effective destruction of space weapons incorporates a twofold meaning. First is the annihilation of a space weapon, second is causing localized structural damage to it and thereby putting it out of operation. Destructive weapons which can be used at present are space defense missiles, killer satellites, high energy laser weapons and particle beam weapons.

In 1962, the U.S. began space defense missile development work based on the "Nike III" anti-missile missile and, in 1963, successfully tested it. It can be used to intercept artificial satellites at an altitude of over 240km. Then in May, 1964, interception tests were also carried out using a modified "Thor" intermediate range ballistic missile which can annihilate high altitude space weapons at over 640km. The kill altitude of space defense missiles is relatively low and, at present, can only be used to destroy a few maneuverable space weapons. In order to intercept maneuverable spacecraft, the U.S. plans to add a homing device to the nose of the missile and at the same time new types of even more powerful space defense missiles are already being actively developed.

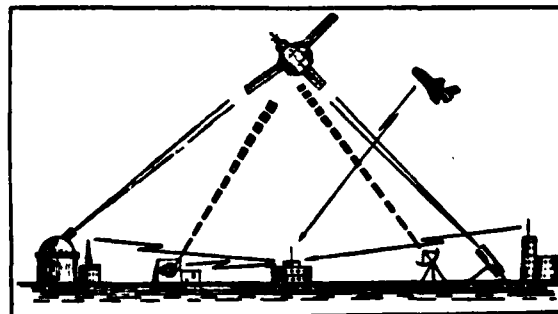
Testing of killer satellites began in 1968. When this satellite approaches a target in orbit, it blows itself up to destroy the other satellite. The Soviet Union has conducted tests with nineteen killer satellites since 1968 and, according to U.S. sources, at least twelve of the tests were successful. In order to improve the kill accuracy of these satellites, in 1977 the U.S. began developing their own collision type killer satellite with a supersensitive "infrared target-seeking device" which is expected to be flight tested within the next two or three years.

High energy laser weapons and particle beam weapons have the advantages of high power, concentrated energy, hit accuracy, and convenience of use. They have received a great deal of attention in countries such as the Soviet Union and the U.S. The U.S. Navy expenditure in the area of high energy laser weapons development amounts to

US\$200,000,000. At present, irradiation by a laser weapon operating on the earth's surface can cause optical and infrared sensors on reconnaissance satellites to lose their sensing ability, thereby achieving the objective of localized damage. In 1975, a U.S. early-warning satellite operating over the Indian Ocean was irradiated and blinded numerous times by a powerful optical source on the earth's surface. In January of the same year, a similar situation occurred when two other U.S. data relay satellites were flying over the Soviet Union. At that time some U.S. officials thought that this very possibly was the result of irradiation by high powered laser weapons used by the Soviet Union. However when laser beams or particle beams are propagated in the air, they are affected by the atmosphere and their energy is attenuated. This situation is even more serious under complicated weather conditions. Therefore, for a ground based high energy laser weapon, good weather must be selected. Due to the special conditions of outer space which are well suited to the development of high energy laser and particle beam weapons, the emergence of the space shuttle in particular has brought good news for laser and particle beam weapons and, because it not only solves the problem of high energy power supplies but also because its operation can be controlled by man, it will become one of the most effective destructive weapons. Some people have even proposed using the space shuttle to carry a capturing capsule which would "seize" an enemy space weapon in outer space and return with it or which would blow up together with the space weapon. This has aroused the interest of several countries.



Destruction



Identification

With the developments in space technology, if there is a major war in the future it will not only be on the ground, but very

possibly be a multi-dimensional war involving outer space, the sky, the land and the sea. Seen from this point of view, defense against space weapons will become one of the component parts of modern warfare.

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